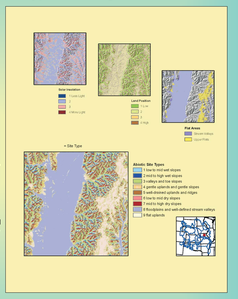
# Identifying Ecological Conservation Areas in EPA Region 7

## Abiotic Site Type Modeling

*Abiotic Site Type Modeling*

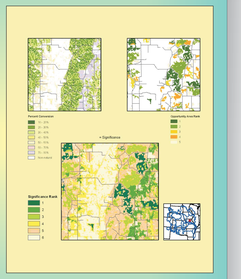
To model abiotic site types, we used neighborhood analyses of 30-m resolution digital elevation models (DEMs). The key variables assigned to each pixel included solar insolation, which integrates slope percent, shading, and exposure, and relative land position. We used a program called Shortwave to calculate solar insolation, and a program developed initially by Frank Biasi of The Nature Conservancy to calculate relative land position within a 9-cell neighborhood. Finally, we placed the pixels into classes (one to four) for solar insolation and land position, and then combined these to identify seven different abiotic site types. Flat uplands were modeled as an eighth site type when local relief within a 9-cell neighborhood was less than 15m, and the pixel was not identified as a floodplain or well-defined river valley bottom, which is the ninth abiotic site type. Finally, we identified all sandy soil types from the digital version of the state soil geographic (STATSGO) soils data layer from the National Resource Conservation and, within the Ozark Highlands planning region, sedimentary rocks versus granitic parent materials based on a digital version of the 1979 geologic map of Missouri.




## Significance

*Final Ecological Significance Data Layer: Percent Conversion and Opportunity Area Representation*

We combined scores for percent conversion and opportunity area representation to create final ecological significance scores. Natural and semi-natural land cover on abiotic site types that have been largely converted to cultural uses were considered more significant, because they represent habitats that were once more common but have become relatively rare in the modern landscape. For example, extant forests on large river floodplains, which have largely been converted to cropland, were considered more important than forest on slopes, since the present-day forests on slopes are relatively intact. Opportunity areas are relatively large patches of natural and semi-natural vegetation that are away from roads and habitat patch edges, and therefore are relatively more likely to be viable and functional, and less likely to be lost to urban development, in the near future. They are ranked based on size by landscape representation. Therefore, they capture the most viable land cover patches across all representative landscape types within each subsection.



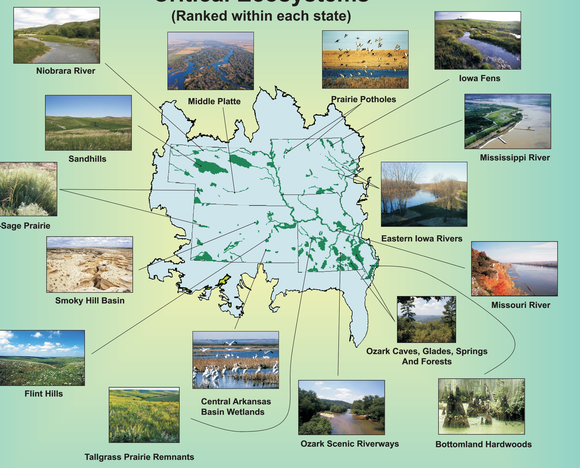

We used current scientific techniques and uniform, transparent methods to identify conservation focus areas as an aid to identification of critical ecosystems. We designed an approach to ensure locally and ecologically relevant results. Key elements include:

1. Separate terrestrial and aquatic assessments.
2. Assessments completed within ecologically-based planning regions (ecoregions for terrestrial ecosystems and evolutionarily significant watersheds for aquatic ecosystems).
3. Use of relatively uniform, region-wide data sets to ensure consistent regional coverage to the maximum extent possible.
4. Evaluation of both biological and abiotic (representation) targets in determining ecological significance whenever possible.
5. Evaluation of both significance/importance and threat/stressors to assign final priorities whenever possible.
6. Assignment of spatially specific results at as fine a resolution as allowed by the data sets.

Terrestrial and aquatic assessments were conducted separately because different stressors operate on aquatic versus terrestrial ecosystems differently, and because watershed boundaries need to be used as aquatic planning regions, since they circumscribe evolutionarily significant sub-divisions of riverine ecosystems. Ecologically-based planning regions were used in order to make results both locally and ecologically more relevant.

## Critical Ecosystems

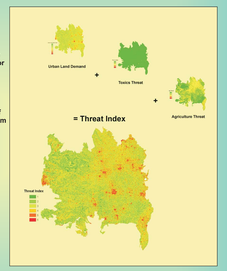
**(Ranked within each state)**




## Threat Index

*Creation of Threats Surface*

The primary threats to ecological integrity in EPA Region 7 result from habitat alteration or destruction due to development of urban infrastructure or conversion of natural vegetation to row crops. For terrestrial ecosystems, there is a lesser threat from toxic releases. The threat index was constructed to reflect these three sources of stress by combining indices constructed from widely available medium to large scale data sets.

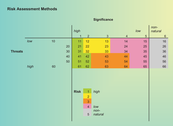



## Risk

*Creation of Ecological Risk Surface: A Combination of Significance and Threat*

By our definition, ecological risk is high when there is a high risk of losing a highly significant patch of natural or semi-natural vegetation. Our approach to combining ecological significance and threat data to create a risk surface was based on the assumption that ecological significance should be weighted more than threat. We also assumed that areas of non-natural vegetation are of low risk, because they are of low functional ecological value. Areas of high significance are important regardless of the threat level, and areas of low significance are low risk regardless of threat. Areas of intermediate significance are more important if the threat is higher.

Risk Assessment Methods



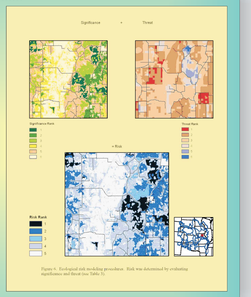
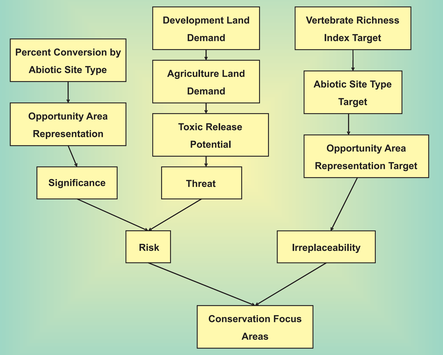




Figure 4. Ecological risk modeling procedure. Risk was determined by evaluating significance and threat (see Table 3).

## Terrestrial Focus Area Identification Model




## Irreplaceability

*Irreplaceability Analysis*

We selected the software package C-Plan to attach irreplaceability values to 40 square kilometer hexagons, our assessment units, within each planning region. The definition of irreplaceability is "the likelihood that a given site will need to be protected to achieve a specified set of targets or, conversely, the extent to which options for achieving these targets are reduced if the site is not protected" (Pressey et al. 1994). A highly irreplaceable hexagon has few or no replacements in the scheme of selected sets of hexagons that achieve the conservation goals within the section.

The irreplaceability of hexagon X is based on the proportion of sets of hexagons that meet the quantitative target goals ("representative sets;" R) that must include hexagon X versus those that meet the target goals without hexagon X:

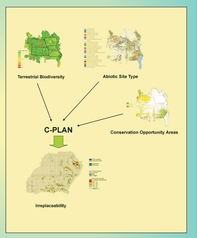
$$\text{Irreplaceability} = \frac{R(x \text{ included}) - R(x \text{ removed})}{R(x \text{ included}) + R(x \text{ removed})}$$

When multiple targets are assessed, the site irreplaceability is equal to the highest irreplaceability value for a given hexagon across all targets, whereas the summed irreplaceability is the sum of all irreplaceability values for all targets for a given hexagon. We were interested in site irreplaceability, so each 40 sq km hexagon was assigned a value between 0 and 1.

For EPA Region 7, we selected targets and set thresholds for capture of targets in EPA R7 as follows:

Abiotic Site Types: 25% of each within the section
Opportunity Areas Ranked #1: 40%
Areas of High Vertebrate Richness: 25% of the top 20% richest areas

Abiotic site type targets ensure representation of habitats, whereas high vertebrate richness is a biotic target. Opportunity areas are both a biotic and abiotic target, since they are the largest, most functional patches of extant semi-natural vegetation of each landscape type by section.




## Terrestrial Focus Areas

*Identification of Conservation Focus Areas: A Combination of Risk and Irreplaceability*

We used the ecological risk and irreplaceability results to identify conservation focus areas. We used logic similar to that used to combine significance and threat to define risk. Areas of highest risk or high irreplaceability and high risk or at least moderate risk and highest irreplaceability were identified as conservation focus areas:

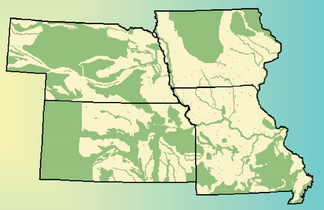
Conservation Focus Area Identification:

Case 1: highest risk (ranked 1) and any irreplaceability
Case 2: high risk (>=2) and high irreplaceability (>=2)
Case 3: at least moderate risk (>=3) and moderate irreplaceability (>=3)

We eliminated all conservation focus area patches that were less than two hectares. An average of 8.3% of each planning region was within conservation focus areas, with a standard deviation of 4.3%. Planning regions that are relatively natural had higher percentages of conservation focus areas. These planning regions included the Nebraska Sand Hills (332C), Flint Hills (251E) and adjacent Cross Timbers and Prairies, and Ozark Highlands (223A) had relatively large patches of natural and semi-natural vegetation that are away from roads and habitat patch edges, which are considered conservation focus areas. Planning regions that are largely cultural such as the North Central Glaciated Plains (251C) and the Central Dissected Till Plains (251B) had relatively small percentages of conservation focus areas. However, due to the scale at which the figures are produced herein, they appear to have more conservation focus areas than they do, because many of the conservation focus areas are small patches of semi-natural vegetation within a sea of row crop agriculture.

Terrestrial conservation focus areas were identified on a planning region by planning region basis across EPA Region 7 using relatively uniform methods and data sets. Even though we used regionally available data sets, inconsistencies in input data and in land use among the regions do exist. For example, roads are developed and mapped differently across EPA Region 7, even in rural areas, and differences in road density have profound impacts on the significance, threats, and risk results. Because of inherent differences among regions, we believe that it is most appropriate to view results on a planning region by planning region (essentially section by section) basis, rather than comparing results across sections. Results within a planning region are both locally relevant and ecologically most meaningful.

The terrestrial conservation focus areas we identified are not ranked within section, so local priorities cannot be discerned. Likewise, they are only polygons of various sizes without names, so local managers and planners will have trouble relating to the results in that regard. To somewhat address this issue, we polled regional resource managers to come up with a list of significant ecological resources shown at right. We then summed the focus areas within these resource areas to generate the map of the highest coincidence above.



U.S. Environmental Protection Agency Region 7 and Missouri Resource Assessment Partnership